Developing a high-sensitivity microchannel plate

S. Matoba[1,2#], S. Kanda[1,2], and M. Tampo[1,2]

[1]*J-PARC Center, Tokai, Ibaraki 319-1195, Japan*
[2]*Institute of Material Life Science, KEK, Tsukuba, Ibaraki 305-0801, Japan*

 # smatoba@post.kek.jp

Microchannel plates (MCPs) are electron multiplier devices that detect charged particles, short wave-length photons, fast neutral particles, etc., and that enable high-speed position and timing detection. The detection efficiency of an MCP is limited by the open-area ratio (OAR) on the MCP surface, because particles are poorly detected if they are not injected into an MCP channel. The OARs of commercial MCPs are typically 50%–60%. The OAR directly affects multiple-coincidence experiments, and the detection efficiency of triple coincidence events is as low as 15%.

To increase the detection efficiency of an MCP, we fabricated a tapered MCP (T-MCP) in which the entrances of the channels were processed to yield a tapered shape that increased the effective OAR.

We examined the absolute ion detection efficiency in single-ion counting mode. The detection efficiency of a chevron-type assembly consisting of a T-MCP (Hamamatsu Photonics F1217-01GMOD, 49.9 mm outside diameter, 0.012 mm channel diameter, 0.48 mm thickness, 8 degree bias angle, 90% OAR) at the first stage and a normal MCP (Hamamatsu Photonics F1217-01, identical in form except for a 57% OAR) at the second stage was compared with the detection efficiency of a chevron-type assembly of normal MCPs. The experiment was conducted using Xe^{q+} (q = 1–3) ions produced by electron impact ionization in the energy range 0.5–13.5 keV. In pulse counting mode, the saturation limit of the MCP output was 10^5 cps (~10 fA). The accuracy of the ion current measurements using a Fara-day cup was low, so the ion beam formed by the slit on the bottom of the Faraday cup was injected into the MCP. The absolute detection efficiency was obtained from the ratio of the count number measured from the MCP assembly and the ion current measured using the Faraday cup[1]. Details of the experimental setup have been described in ref[2].

We are developing this highly sensitive microchannel plate for application to muon detection. In the presentation, we will describe our recent muon irradiation experiments.

[1] S. Matoba *et al.*, Jpn. J. Appl.Phys. 50, 112201(4pp), (2011)

[2] T. Koizumi and Y. Chihara, 2009 J. Phys. Conf. Ser. 163, 01211